

**TUV Rheinland (India) Pvt. Ltd.
Product Safety &Quality**

Test Report

**Salt Mist corrosion Testing of
Photovoltaic modules acc IEC 61701-2011**

TÜV Report No: 19631432.001

Bangalore July 2017

Test report no.: <i>Prüfbericht - Nr.:</i>	19631432.001		
Client (Customer no. and address): Auftraggeber (Kunden-Nr. u. Adresse):	651704 Insolation Energy Pvt. Ltd, G-25, City Centre, SC Road, Jaipur -302001, Rajasthan India		
Test item: <i>Gegenstand der Prüfung:</i>	Photovoltaic (PV) Module(s)	Date of receipt: <i>Eingangsdatum:</i>	18-03-2017
Module type designation: <i>Modultypen-Bezeichnung:</i>	Refer Page.no 3 (only valid for the material combination as listed in the constructional data form in the annex of this test report)		
Order no.: <i>Auftragsnummer:</i>	1803192499	Quotation no.: <i>Angebotsnummer:</i>	402035499 dtd 22-11-2016
Testing location: <i>Prüfört:</i>	TUV Rheinland(India) Pvt.Ltd Plot No.17B, Electronic city, Phase II, Industrial Area, Begur Hobli, Bangalore(south)-560 100, India Tel: +91 80 3923 4301		
Test specification: <i>Prüfgrundlage:</i>	IEC 61701:2011, EN 61701:2012 severity 1, (Salt mist corrosion testing of photovoltaic (PV) modules)		
Test result: <i>Prüfergebnis:</i>	All of the required tests were passed according to the pass criteria outlined in test specification noted above.		
compiled by / erstellt: 24-07-2017 K. Ganesh Kamath		reviewed by / kontrolliert: 24-07-2017 Kamalaksha CS	
Date <i>Datum</i>	Title/Name <i>Titel/Name</i>	Date <i>Datum</i>	Title/Name <i>Titel/Name</i>
<p>This test report relates to the listed test samples. Without permission of the test centre this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.</p> <p>Dieser Prüfbericht bezieht sich nur auf die gelisteten Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</p>			

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Product description:

1	<p>Produktdetails <i>Product details:</i> <u>With 6" poly cells:</u> INA72Pxxx(xxx = 290 -355 in steps of 1with 72 cells) INA60Pxxx(xxx = 240 -295 in steps of 1with 60 cells) INA54Pxxx(xxx = 220 -270 in steps of 1with 54 cells) INA48Pxxx(xxx = 195 -240 in steps of 1with 48 cells) INA36Pxxx(xxx = 145 -180 in steps of 1with 36 cells)</p> <p>xxx represents Output power in Wp</p>
2	<p>Verwendete Materialien <i>Used materials</i></p> <p>see Constructional Data Form (CDF) in the annex of this test report</p>
3	<p>Adresse(n) der Fertigungsstätte(n) <i>Address(es) of the manufacturing site(s)</i></p> <p>Insolation Energy Pvt. Ltd, 25KM Milestone, Jaipur – Delhi Bypass, Near Daulatpura Toll Tax, Vill – Bagwara, Jaipur -303805, Rajasthan- India</p>
4	<p>Zusammenfassung der Prüfergebnisse <i>Summary of test results</i></p> <p>According to the inquiry of manufacturer for resistance to salt mist corrosion of photovoltaic (PV) modules should be assessed in accordance with IEC 61701:2011- Severity 1. For the qualification of the modules to this test, initial and final control measurements were performed before and after the salt mist corrosion testing. The measurements included relative power measurements, insulation testing and visual inspections. The maximum permissible power degradation of 5 % must not be exceeded. Furthermore the minimum requirements for the –Dielectric-insulation test and wet leakage test as defined in MST 16 of IEC 61730-2 and IEC 61215:2005-10.15 have to be met. No major visual defects as defined in IEC 61730-2 shall occur. " The tests have been performed on the representative sample of the above said type and results were incorporated in this report: 19631432.001</p> <p>The tests of the requirements of IEC 61701:2011- Severity 1 were all fulfilled according to its regulations of the pass criteria. The above listed module types have passed all tests of the IEC 61215:2005 standard before salt mist corrosion test was applied.</p> <p>Test failures: - N/A</p>

GENERAL INFORMATION:**Abbreviations used in the report:**

Impp	– Maximum power point current	Vmpp	– Maximum power point voltage
STC	– Standard Test Conditions	Voc	– Open circuit voltage
Isc	– Short circuit current	FF	– Fill factor
Pmpp	– Maximum power		

Possible test case verdicts:

- test case does not apply to the test object: N/A
- test object does meet the requirement: Passed (P)
- test object does not meet the requirement: Failed (F)

Date of receipt of test item:: 18-03-2017

Condition of EUT when received.....: Good

Date(s) of performance of tests.....: 24-05-2017 to 04-07-2017

General remarks:

The test verdicts presented in this report relate only to the object tested.

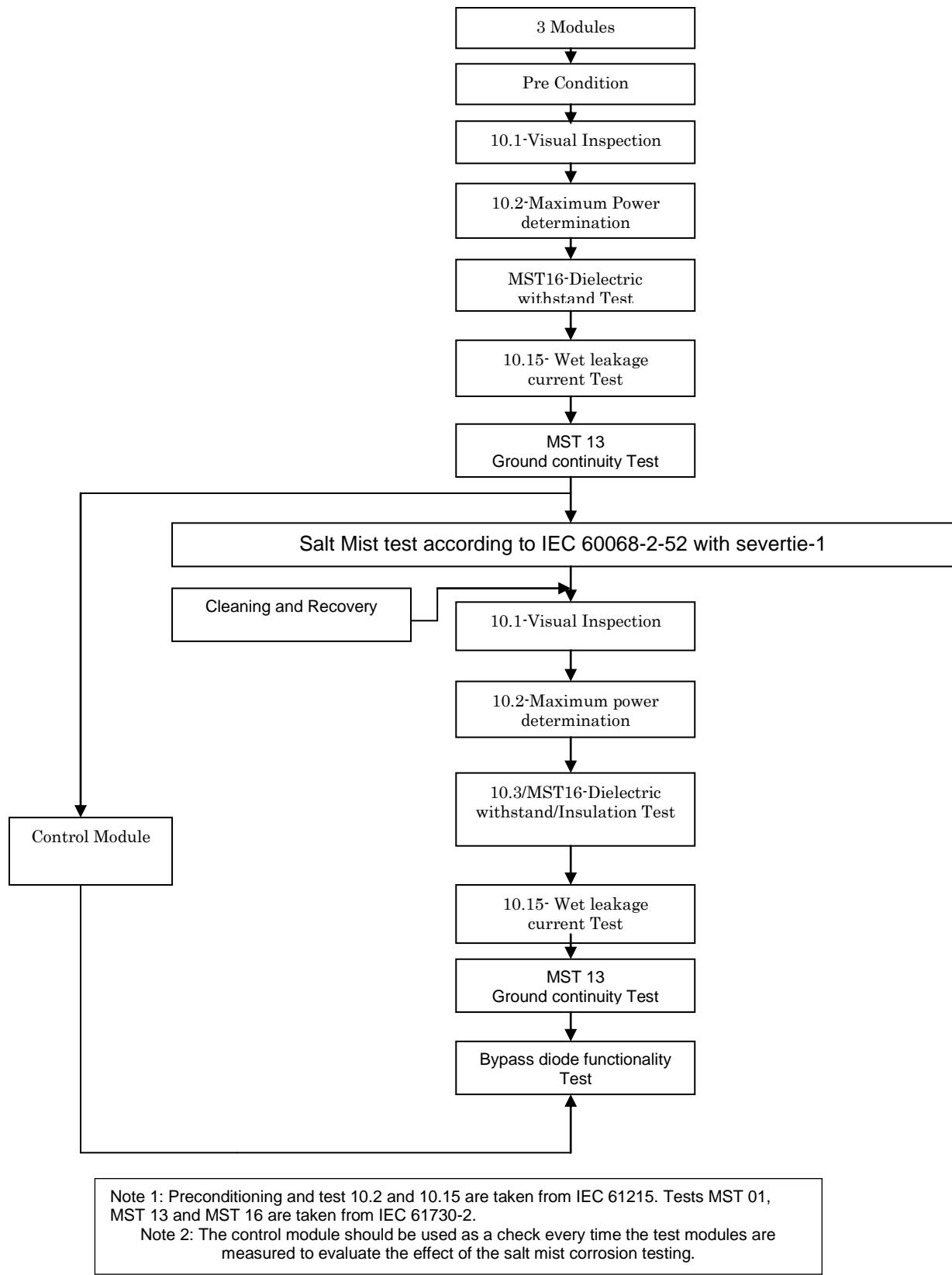
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Throughout this report a point is used as the decimal separator.

Module assignment:

TUV Sample #	Sample S/N	Position in the test sequence	Remarks / constructional characteristics (e.g. EVA back sheet, frame type)
1803192499-21	INA7217063156	Control	Cell: Tainergy Tech Co., Ltd - Multi Crystalline, 4BB EVA: Conserv P UVT-14FC Back Sheet: PRESERV 1-150 WD Frame: Indo Alusys Industries Front cover: Gujarat Borosil-3.2mm
1803192499-22	INA7217063157	Salt mist	
1803192499-23	INA7217063158	Salt mist	

Salt mist corrosion testing procedure for crystalline silicon PV modules:



IEC 61701:2011, Severity 1, Salt mist corrosion testing of photovoltaic (PV) modules			
Clause	Requirement + Test	Verdict - Remark	Verdict

Tables:**Visual inspection (Initial): MST 01**

Test date [DD/MM/YYYY]	24-05-2017	—
Sample #	Nature and position of initial findings	—
1803192499-21	No major visual defects found	P
1803192499-22	No major visual defects found	P
1803192499-23	No major visual defects found	P
Supplementary information: None		

Maximum power determination (Initial):10.2

Test Date [DD/MM/YYYY]	24-05-2017	—				
Module temperature [°C]	Corrected to 25	—				
Irradiance [W/m ²]	1000	—				
Sample #	Pmpp [W]	Vmpp [V]	Impp [A]	Voc [V]	Isc [A]	FF [%]
1803192499-21	23.85	2.75	8.67	3.89	9.25	67.53
1803192499-22	21.12	2.48	8.52	3.84	9.70	56.61
1803192499-23	23.65	2.68	8.80	3.84	9.69	63.46
Supplementary information: None			—	—	—	—

Dielectric-Insulation Test (Initial): MST 16

Test date [DD/MM/YYYY]	29-05-2017	—				
Maximum system voltage [V _{DC}]	1500	—				
High voltage applied [V _{DC}]	8000	—				
Insulation resistance measured at [V _{DC}]	1500	—				
Sample #	Measured	Area	Result*	Dielectric breakdown		—
	[GΩ]	[m ²]	[GΩ * m ²]	Yes (description)	No	
1803192499-21	58.00	0.35	20.30	-	No	P
1803192499-22	58.00	0.35	20.30	-	No	P
1803192499-23	57.00	0.35	19.90	-	No	P
Supplementary information: None			—	—	—	—

Wet leakage current test (Initial): 10.15

Test date [DD/MM/YYYY]	29-05-2017			—
Test voltage Applied[V _{DC}]	1500			—
Solution resistivity [Ω cm]	< 3,500			—
Solution temperature [°C]	22 ± 3			—
Sample #	Measured	Area	Result*	—
	[MΩ]	[m ²]	[MΩ * m ²]	
1803192499-21	10900.0	0.35	3815.0	P
1803192499-22	10300.0	0.35	3605.0	P
1803192499-23	11100.0	0.35	3885.0	P
Supplementary information: None				
* Minimum requirement acc. to the standard is 40 MΩ*m ² .				

Ground continuity Test(Initial): MST 13

	Test date [DD/MM/YYYY]	29-05-2017		—
	Maximum over-current protection rating [A]	15.0		—
	Current applied [A]	37.5		—
	Location of Ref grounding point	Right side Longer frame		—
Sample No	Location	Voltage [mv]	Resistance [mΩ]	—
1803192499-21	Ref- Adjacent frame 1	281.2	7.49	P
	Ref- Adjacent frame 2	258.4	6.88	P
	Ref- Opposite frame	282.1	7.52	P
1803192499-22	Ref- Adjacent frame 1	262.1	6.98	P
	Ref- Adjacent frame 2	248.2	6.61	P
	Ref- Opposite frame	252.1	6.72	P
1803192499-23	Ref- Adjacent frame 1	218.9	5.83	P
	Ref- Adjacent frame 2	194.9	5.19	P
	Ref- Opposite frame	219.0	5.84	P
Supplementary information: None				
* Minimum requirement acc. to the standard is <0.1Ω.				

Performance of salt mist corrosion test:

Test date [DD/MM/YYYY] start / end	01-06-2017 to 30-06-2017	-
Severity used	Severity-1 as per IEC 60068-2-52	-
NaCl - concentration[%]	5	-
Temperature[°C]	35	-
Relative Humidity [%]	Approx. 93	-
Course of cycle(7 days)	Four spray periods, each of 2 h, with a humidity storage period of seven days after each.	
Duration:	4 cycles = 28 days	
Sample #	Remark	-
1803192499-22	-	-
1803192499-23	-	-
Supplementary information: None		

Visual inspection after salt mist corrosion test: MST 01

Test date [DD/MM/YYYY]	30-06-2017	—
Sample #	Nature and position of initial findings	—
1803192499-22	No major visual defects found	P
1803192499-23	No major visual defects found	P
Supplementary information: none		

Maximum power determination after Salt mist corrosion Test: 10.2

Test Date [DD/MM/YYYY]	30-06-2017							
Module temperature [°C]	Corrected to 25							
Irradiance [W/m ²]	1000							
Sample #	Pmpp [W]	Vmpp [V]	Impp [A]	Voc [V]	Isc [A]	FF %	Degradation [%]	
1803192499-22	21.96	2.73	8.04	3.85	8.69	65.58	-3.9	P
1803192499-23	24.23	2.88	8.41	3.85	9.06	69.45	-2.4	P
Supplementary information: Initial measurements were considered for calculating degradation. Maximum allowable Pmpp degradation after this test is 5%.								

Dielectric Insulation after salt mist corrosion Test:

Test date [DD/MM/YYYY]				30-06-2017			—
Maximum system voltage [V _{DC}]				1500			—
High voltage applied [V _{DC}]				8000			—
Insulation resistance measured at [V _{DC}]				1500			—
Sample #	Measured	Area	Result*	Dielectric breakdown			—
	[GΩ]	[m ²]	[GΩ * m ²]	Yes (description)		No	
1803192499-22	15.20	0.35	5.32	-		No	P
1803192499-23	8.47	0.35	2.96	-		No	P
Supplementary information: None							

Wet leakage current test after salt mist corrosion Test:

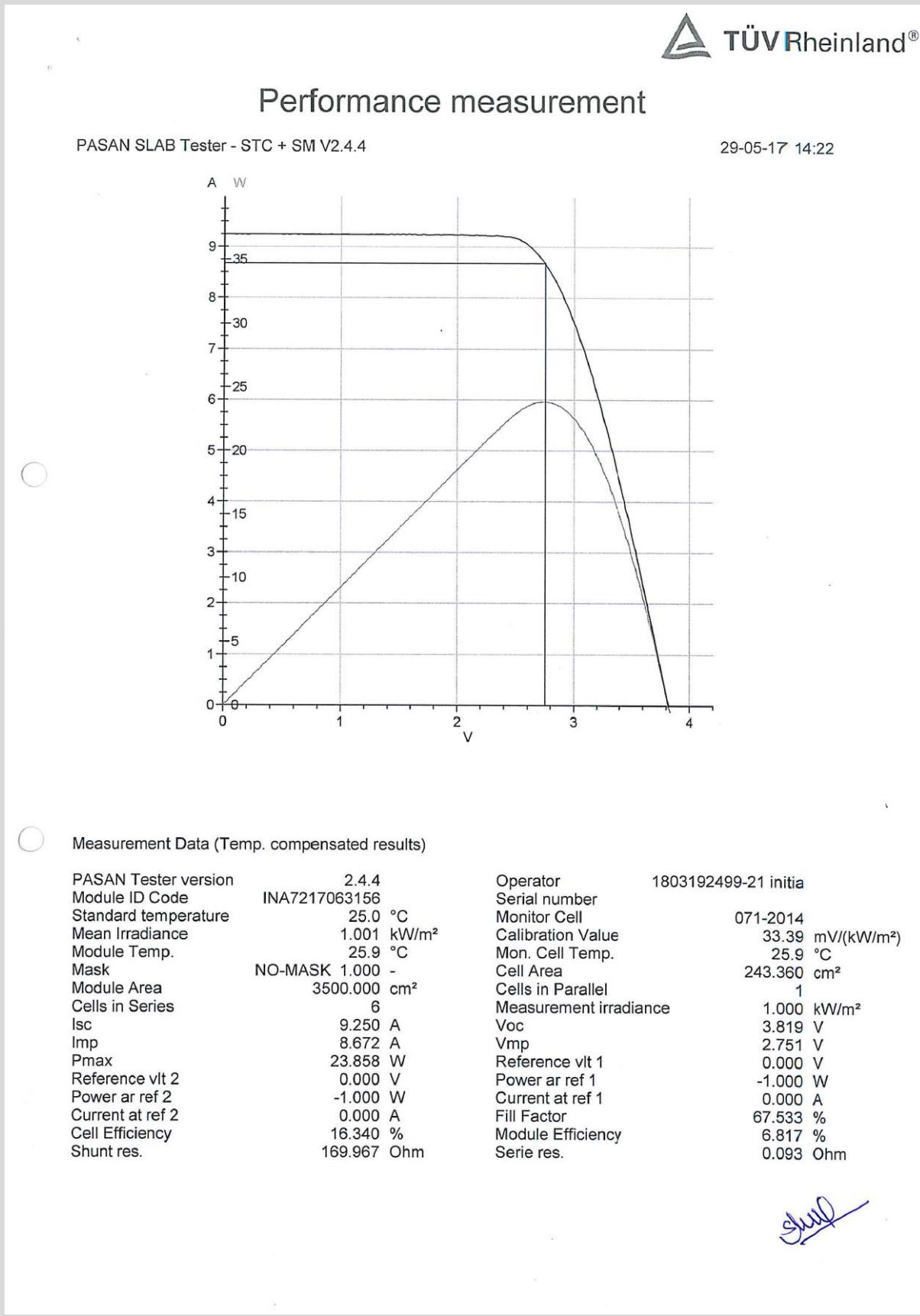
Test date [DD/MM/YYYY]		30-06-2017			—
Test voltage Applied[V _{DC}]		1500			—
Solution resistivity [Ω cm]		< 3,500			—
Solution temperature [°C]		22 ± 3			—
Sample #	Measured	Area	Result*	—	
	[MΩ]	[m ²]	[MΩ * m ²]		
1803192499-22	1070.0	0.35	374.5	P	
1803192499-23	1270.0	0.35	444.5	P	
Supplementary information: None					

Ground continuity Test after Salt Mist Corrosion Test:

	Test date [DD/MM/YYYY]		30-06-2017		—		
	Maximum over-current protection rating [A]		15		—		
	Current applied [A]		37.5		—		
	Location of Ref grounding point		Right side Longer frame		—		
Sample No	Location		Voltage [mv]	Resistance [mΩ]	—		
			280.1	7.46	P		
1803192499-22	Ref- Adjacent frame 1		179.3	4.78	P		
	Ref- Adjacent frame 2		178.2	4.75	P		
	Ref- Opposite frame		163.9	4.37	P		
1803192499-23	Ref- Adjacent frame 1		354.1	9.44	P		
	Ref- Adjacent frame 2		192.8	5.14	P		
	Ref- Opposite frame						
Supplementary information: None							
* Minimum requirement acc. to the standard is <0.1Ω.							

Bypass Diode Functionality Test after Salt mist corrosion Test:

Diode Type		PST4020								
Number of diodes in Junction Box		03								
Diode manufacturer		ZJRH								
Max. Permissible junction temperature T _{jmax} :°C		200								
Test date	Module serial number	Forward bias voltage drop across diodes in volts			Total voltage drop across module-V	Diode Temperature at reverse bias in °C			Diode Breakdown (YES / NO)	Result
		Dp1	Dp2	Dp3		Dp1	Dp2	Dp3		
04-07-2017	1803192499-22	0.33	0.32	0.33	0.98	26.8	26.9	26.7	No	P
04-07-2017	1803192499-23	0.33	0.31	0.33	0.97	26.7	26.8	26.9	No	P
Supplementary information:.. None										

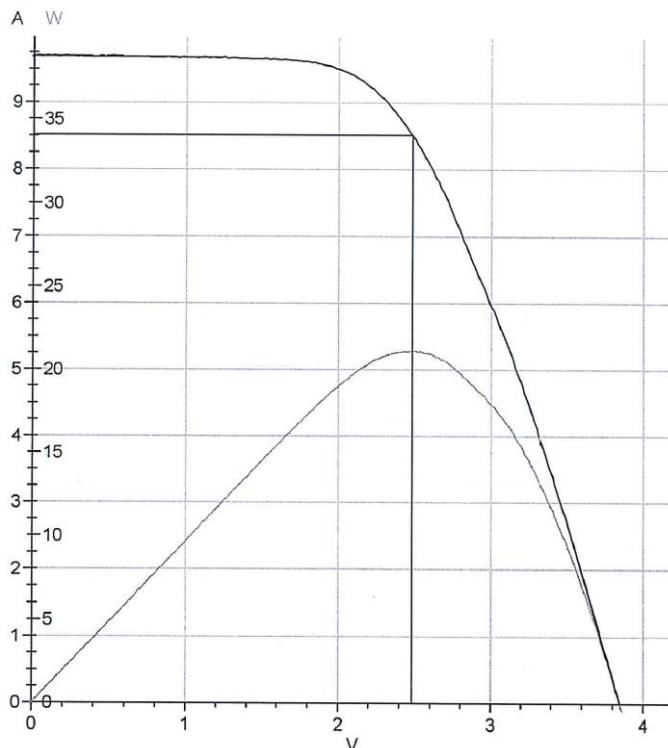
Annexure-1: Measurement Reports: Initial




Performance measurement

PASAN SLAB Tester - STC + SM V2.4.4

29-05-17 14:28



Measurement Data (Temp. compensated results)

PASAN Tester version	2.4.4	Operator	1803192499-22 initia
Module ID Code	INA7217063157	Serial number	
Standard temperature	25.0 °C	Monitor Cell	071-2014
Mean Irradiance	1.001 kW/m²	Calibration Value	33.39 mV/(kW/m²)
Module Temp.	25.9 °C	Mon. Cell Temp.	25.9 °C
Mask	NO-MASK 1.000 -	Cell Area	243.360 cm²
Module Area	3500.000 cm²	Cells in Parallel	1
Cells in Series	6	Measurement irradiance	1.000 kW/m²
Isc	9.698 A	Voc	3.849 V
Imp	8.517 A	Vmp	2.481 V
Pmax	21.129 W	Reference vlt 1	0.000 V
Reference vlt 2	0.000 V	Power ar ref 1	-1.000 W
Power ar ref 2	-1.000 W	Current at ref 1	0.000 A
Current at ref 2	0.000 A	Fill Factor	56.611 %
Cell Efficiency	14.470 %	Module Efficiency	6.037 %
Shunt res.	60.016 Ohm	Serie res.	0.128 Ohm

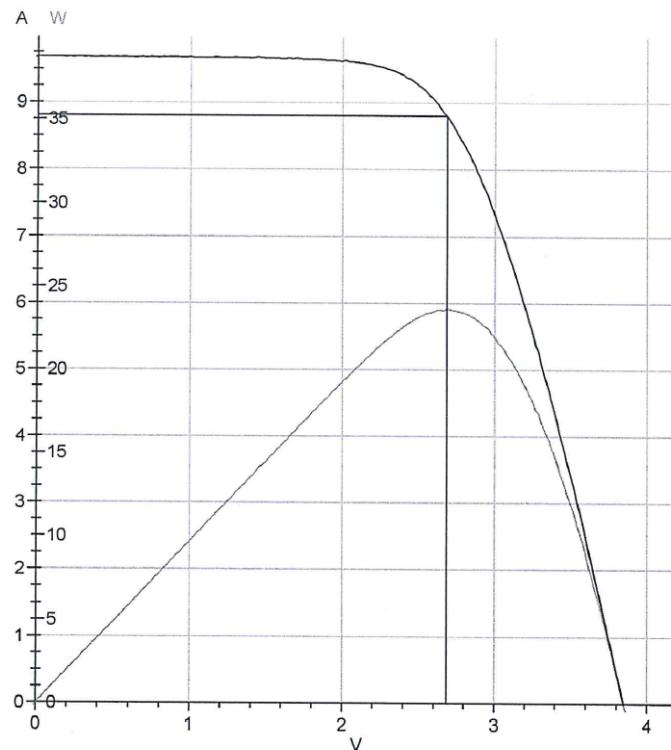




Performance measurement

PASAN SLAB Tester - STC + SM V2.4.4

29-05-17 14:25



Measurement Data (Temp. compensated results)

PASAN Tester version	2.4.4	Operator	1803192499-23 initia
Module ID Code	INA7217063158	Serial number	
Standard temperature	25.0 °C	Monitor Cell	071-2014
Mean Irradiance	1.001 kW/m ²	Calibration Value	33.39 mV/(kW/m ²)
Module Temp.	26.0 °C	Mon. Cell Temp.	26.0 °C
Mask	NO-MASK 1.000 -	Cell Area	243.360 cm ²
Module Area	3500.000 cm ²	Cells in Parallel	1
Cells in Series	6	Measurement irradiance	1.000 kW/m ²
Isc	9.688 A	Voc	3.847 V
Imp	8.800 A	Vmp	2.688 V
Pmax	23.654 W	Reference vlt 1	0.000 V
Reference vlt 2	0.000 V	Power ar ref 1	-1.000 W
Power ar ref 2	-1.000 W	Current at ref 1	0.000 A
Current at ref 2	0.000 A	Fill Factor	63.462 %
Cell Efficiency	16.199 %	Module Efficiency	6.758 %
Shunt res.	84.637 Ohm	Serie res.	0.100 Ohm



Annex 2: Statement of the estimated uncertainty of the test verdicts:

- Electrical performance rating is outside the scope of IEC 61215:2005 qualification testing. The verdicts of performance rating are only related to the test samples that were subjected to the tests. They cannot be generalised to the modules from the series production.
- The calibration to STC was performed with a class AAA solar simulator. The extended measurement uncertainty is:
 - Pmax measurement: 2.14% with a coverage factor k=2
 - Current measurement: 1.87% with a coverage factor k=2
 - Voltage measurement: 1.63% with a coverage factor k=2
- Relative measurements were performed with a flash type solar simulator.
- The accuracy of measurement reproduction with the solar simulator is less than ±1%.
-

Annex 3: History of certification:

Subject	Module type	Project no/ Report no.	Certificate no./ Declaration on extension	Date of issue
Basic qualification	INA72xxx/INA60xxx/INA54xxx/INA48xx/INA36xxx	21275533.001	PV 60121871	18-07-2017

Annexure 4: Constructional details of PV Module:

A1.1.1	Module type	: Refer Page no.3
A1.1.2	Solar cell	
	Cell type reference	Tainergy Tech Co., Ltd – Multi crystalline - 4BB - TIM-xxxx Series
	Cell dimensions L x W (mm)	156.75 x156.75
	Cell thickness (μm)	200 \pm 20 μm
	Cell area (cm^2)	243.4
A1.1.3	Identification of materials	
	Front cover	Gujarat Borosil – 3.2mm
	Rear cover	RenewSys - PRESERV 1-150 WD
	Encapsulate	RenewSys - Conserv P UVT-14FC(Front) RenewSys - CONSERV P 360-14FC (Back)
	Frame	Indo Alusys Industries Limited
	Adhesive for frame	Sikasil AS-60 CN
	Adhesive for junction box	Sikasil AS-60 CN
	Potting material	N/A
	Soldering material	Kester-245
A1.1.4	Identification of components	
	Junction box	Zhejiang Renhe Photovoltaic Technology Co., Ltd- PV-RH101tc
	Cable	Zhejiang Renhe Photovoltaic Technology Co., Ltd - PV1-F – 1x4sqmm
	Connector	Zhejiang Renhe Photovoltaic Technology Co., Ltd - 05-06
	Bypass diode	PST4020/T - Zhejiang Renhe Photovoltaic Technology Co., Ltd
	Cell connectors	Gebauer & Griller - 1.2mm x 0.20mm(Sn60 Pb40)
	String connectors	Gebauer & Griller - 5.0mm x 0.30mm(Sn60 Pb40)

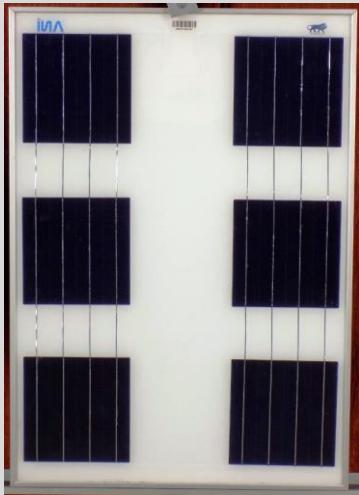
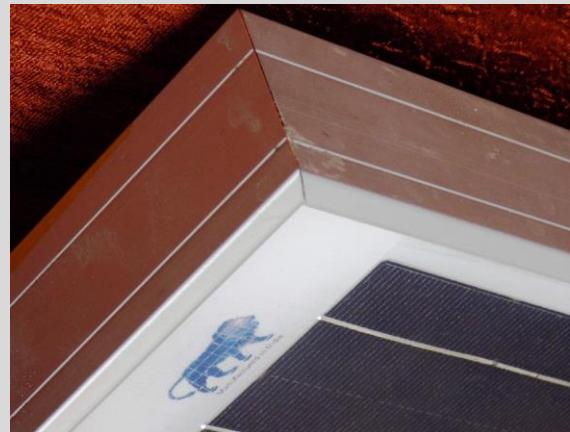
Annexure 5: Pictures of Test Sample: (Initial)

Fig 1: Front view of the module

Fig 2: Rear view of the module

Fig 3: detail view of closed Junction Box

Fig 4: detail view of open Junction Box

Fig 5: detail view of Type label

Fig 6: detail view of frame corner

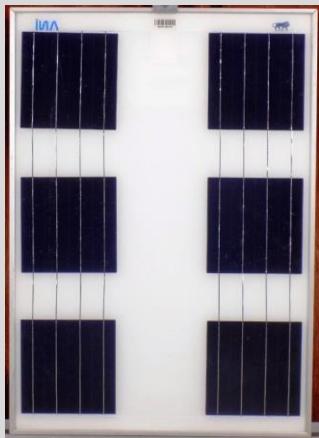
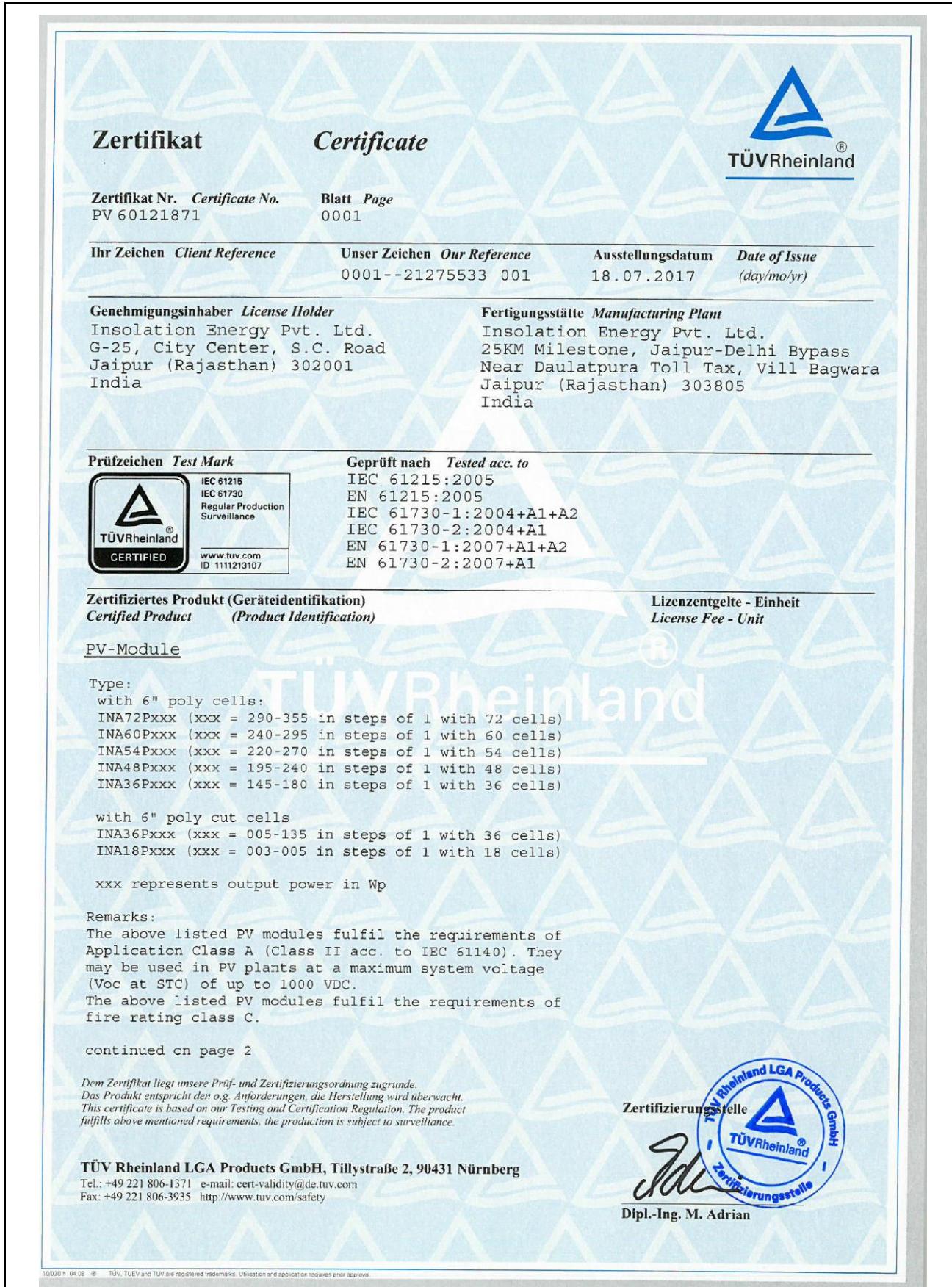
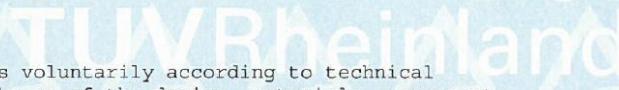
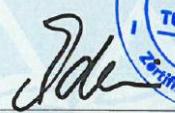
Pictures of Test Sample: (After salt mist)

Fig 13: Front view of the Frame inner corner
Fig 14: Rear view of the module

Fig 15: detail view of closed Junction Box
Fig 16: detail view of open Junction Box

Fig 17: detail view of frame Corners
Fig 18: detail view of frame corners

Annexure 6: Certificate Copy of IEC 61215 and IEC 61730 :


Zertifikat Certificate	 TÜV Rheinland
Zertifikat Nr. / Certificate No. PV 60121871 Blatt / Page 0002	
Ihr Zeichen / Client Reference Unser Zeichen / Our Reference 0001-21275533 001 Ausstellungsdatum / Date of Issue 18.07.2017 (day/mo/yr)	
Genehmigungsinhaber / License Holder Insolation Energy Pvt. Ltd. G-25, City Center, S.C. Road Jaipur (Rajasthan) 302001 India	Fertigungsstätte / Manufacturing Plant Insolation Energy Pvt. Ltd. 25KM Milestone, Jaipur-Delhi Bypass Near Daulatpura Toll Tax, Vill Bagwara Jaipur (Rajasthan) 303805 India
Prüfzeichen / Test Mark  Geprüft nach / Tested acc. to IEC 61215:2005 EN 61215:2005 IEC 61730-1:2004+A1+A2 IEC 61730-2:2004+A1 EN 61730-1:2007+A1+A2 EN 61730-2:2007+A1	
Zertifiziertes Produkt (Geräteidentifikation) / Certified Product (Product Identification) <u>PV-Module</u> Conditions: The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval. The certificate has a validity of 5 years counting from date of issue.	Lizenzentgelte - Einheit / License Fee - Unit 
<i>Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde. Das Produkt entspricht den o.g. Anforderungen, die Herstellung wird überwacht. This certificate is based on our Testing and Certification Regulation. The product fulfills above mentioned requirements, the production is subject to surveillance.</i>	
TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg Tel.: +49 911 806-1371 e-mail: cert-validity@de.tuv.com Fax: +49 911 806-3935 http://www.tuv.com/safety	
  Dipl.-Ing. M. Adrian	